Code No: RR320801

Set No. 1

III B.Tech Supplimentary Examinations, Aug/Sep 2008
MASS TRANSFER OPERATIONS-II
(Chemical Engineering)
Time: 3 hours   Max Marks: 80
Answer any FIVE Questions
All Questions carry equal marks
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1. (a) Draw the boiling diagram and equilibrium diagrams for a minimum boiling axeotrope and maximum boiling azeotrope.

   (b) With the help of the above diagrams explain what is a minimum boiling azeotrope and maximum boiling azeotrope.   [8+8]

2. A mixture of 30% A and rest B is to be distilled. The concentration of A in the distillate is 90% and 95% of all A is in the distillate. The feed is half vapor. The relative volatility of A with respect to B is 2.75.

   (a) Determine the minimum reflux ratio.

   (b) Find out the minimum number of plates required for this separation.

   (c) If operating reflux ratio is 2 times the minimum reflux ratio, find the number of theoretical stages.   [16]

3. (a) What is an azeotrope? Give few examples.

   (b) What is the importance of extractive distillation.

   (c) With neat figure explain the process of extractive distillation. Mention its application in the industries.   [4+4+8]

4. Write about the various quantities to be considered in making a choice of solvent.   [16]

5. Discuss continuous countercurrent multistage extraction and explain how it is shown on a triangular chart. Indicate how the quantities and compositions of extract and raffinate are computed. For a given separation indicate how the number of equilibrium stages required is found.   [16]

6. (a) Discuss the different types of solid- liquid equilibrium diagrams with neat sketches?

   (b) A groundnut oil cake containing 10% oil is to be extracted at 2000 kg / hr using 1500 kg / hr of pure hexane in a countercurrent multistage extraction unit. Cake retains 0.35 kg solution per kg of oil free cake. Calculate the number of ideal stages required to reduce the oil content of the cake to 1%.   [16]

7. Write short notes on:

   (a) Contact filtration of liquids.

(b) Adsorption isotherm of concentrated solutions. [8+8]

8. (a) Explain about solvent recovery adsorption plant?

(b) Write short notes on idealised break through curve. [10+6]

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Set No. 2

III B.Tech Supplimentary Examinations, Aug/Sep 2008
MASS TRANSFER OPERATIONS-II
(Chemical Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks
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1. (a) A 20 mole% of benzene in toluene is to be distilled in a batch operation to obtain a product having an average composition of 60 mole% benzene. Calculate the amount of residue per 500 kgmole of feed.
   Equilibrium data:

X	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Y	0.21	0.35	0.51	0.64	0.72	0.79	0.86	0.91	0.96

   (b) Explain positive deviation from ideality, for solutions with a neat schematic diagram. [10+6]

2. Explain the step-by-step procedure for the calculation of theoretical number of plates of a distillation column by McCabe-Thiele method. Mention the assumption made and its limitations. [16]

3. (a) Distinguish between point efficiency, murphree plate efficiency and over all plate efficiency in a distillation column.

   (b) Derive an expression to calculate tower height for packed bed distillation. [6+10]

4. (a) Discuss about the fields of usefulness of liquid - liquid extraction

   (b) Explain equilateral triangular coordinates to represent ternary liquid systems. [6+10]

5. 200 kg of aqueous acetic acid solution containing 25% acetic acid is to be extracted with 150 kg of isopropyl ether solvent at 20^0C. Two batch extractions are to be done with fresh and pure solvent. Estimate the quantities and compositions of the raffinate and extract products using right triangular diagram method. The tie line data for the above system are:

Water layer, wt %			Ether layer, wt%		
A	B	C	A	B	C
98.1	1.2	0.69	0.50	99.3	0.18
95.5	1.6	2.89	0.80	98.4	0.79
84.4	2.3	13.3	1.90	93.3	4.82
71.1	3.4	25.5	3.90	84.7	11.40
59.8	4.4	36.7	6.90	71.5	21.6
37.1	16.5	46.4	15.10	48.7	36.20

   A - Water, B - Ether, C - Acetic Acid [16]

Set No. 2

6. (a) Explain percolation method of leaching.

 (b) Describe the different types of tanks used in percolation operation.

 (c) Describe the sequence of procedures to be followed in percolation tank operation. [2+10+4]

7. (a) Prove that for cross current two stage treatment of liquid solutions by contact filtration, when the adsorption isotherm is linear, the least total adsorbent results if the amount used in this stages are equal. Explain.

 (b) Discuss about the effect of temperature and pressure on adsorption. [10+6]

8. (a) State the principles of ion exchange.

 (b) Derive the equation to calculate the length of used bed. [6+10]

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$\boxed{\textbf{Set No. 3}}$

III B.Tech Supplimentary Examinations, Aug/Sep 2008
MASS TRANSFER OPERATIONS-II
(Chemical Engineering)

Time: 3 hours   Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks
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1. A binary mixture of benzene and toluene containing 40 mole % benzene is to be distilled at atmospheric pressure to recover 95% of the benzene. Estimate the molal percent of the mixture that should be distilled and the composition of the distillate obtained, if the distillation is carried out by

    (a) Simple equilibrium distillation

    (b) Differential distillation collecting all the distillate together

    The average relative volatility of benzene to toluene in the temperature range involved is 2.5.   [8+8]

2. Derive the relationship for the intersection of the operating lines corresponding to the rectifying and stripping sections of distillation column for various thermal conditions of the feed.   [16]

3. (a) Distinguish between point efficiency, murphree plate efficiency and over all plate efficiency in a distillation column.

    (b) Derive an expression to calculate tower height for packed bed distillation. [6+10]

4. (a) What are the different coordinate by which liquid - liquid equilibrium can be represented?

    (b) Discuss cross current multistage extraction operation of insoluble liquids?
                                                                                      [8+8]

5. Discuss about the following equipment for liquid-liquid extraction with neat diagrams:

    (a) Mixer-settler cascade

    (b) Gravity settlers   [16]

6. Ten tons per hour of dry sea shore sand, containing 2 percent by weight of salt is to be washed with 15 tons per hour of fresh water running countercurrent to the sand through two classifiers in series. Assume that perfect mixing of sand and water occurs in each classifier and that the sand discharged from each classifier contains one part of water for every two of sand (by weight). If the washed sand is dried, what will be the salt content?
    Assume operating line and equilibrium line to be straight in the operating concentration range. Any assumptions made are to be stated clearly.   [16]

Set No. 3

7. (a) Differentiate van der Waals adsorption isotherm and chemisorption

   (b) Define adsorption?

   (c) List out the properties of Adsorbents?   [8+2+6]

8. (a) Derive the rate of adsorption in fixed beds?

   (b) What are the factors determining rate of ion exchange?   [10+6]

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Code No: **RR320801**

$\boxed{\textbf{Set No. 4}}$

III B.Tech Supplimentary Examinations, Aug/Sep 2008
MASS TRANSFER OPERATIONS-II
(Chemical Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks
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1. (a) A liquid mixture containing

    i. 50mole% heptane

    ii. and 50 mole% octane

    is to be continuously flash vaporised at 1 standard atmosphere pressure to vaporise 60 mole% of the feed. What will be the composition of the vapour and liquid in the separator for an equilibrium stage?
    Equilibrium Data:

T^{o}C	98.5	105	110	115	120	125.5
Vapour pressure A mm Hg	760	940	1050	1200	1350	1540
Vapour pressure B mm Hg	333	417	484	561	650	760

   (b) Explain negative deviation from ideality for solutions with a neat schematic diagram. [10+6]

2. A saturated liquid feed containing 40 mole % chloroform and 60 mole % benzene is fed to a continuous fractionating column to yield a distillate and residue product with 95 mole % chloroform and 95 mole % benzene respectively. The VLE data may be represented by the following relationship.
   y = $1.29x + 0.25x^2$ - $0.54x^3$
   x, y - mole fractions of chloroform in the liquid and vapor. Determine

   (a) The minimum number of plates

   (b) The number of plates when the reflux ratio is such as to make the operating line slope = 1.18. [16]

3. An equimolar binary mixture of completely miscible components is to be separated in a packed distillation column operated at atmospheric pressure. The relative volatility is 1.2. The distillate product to be obtained should contain 95 mole% of the more volatile component bottom product contains 5 mole % of the mole volatile component. Compute for this case, the number of transfer units required if the column is operated at total reflux. [16]

4. Write about the various quantities to be considered in making a choice of solvent. [16]

5. Discuss about the following differential extractors:

   (a) Mechanically agitated, countercurrent extractors

(b) Centrifugal extractors [16]

6. (a) With a neat sketch explain the construction and operation of Kennedy extractor.

(b) Explain the method of calculation of stage efficiency in leaching.

(c) In practice, stage efficiency is always less than 100 percent. Why? [11+3+2]

7. Write short notes on:

(a) Contact filtration of liquids.

(b) Adsorption isotherm of concentrated solutions. [8+8]

8. A solvent recovery plant is to recover 0.1kg /sec.of ethyl acetate vapor from a mixture with air at a concentration of 3kg vapor / $100m^3$ and 1 std atm.pressure.The adsorbent will be activated carbon of 2.8mm and apparent density of individual particles 720kg /m^3 Apparent density of the packed bed is 480kg /m^3 .The carbon is capable of adsorbing 0.45kg vapor/kg carbon to the break point.The adsorption cycle will set at 3hrs to allow sufficient time for regeneration

(a) Determine the amount of carbon required

(b) Choose suitable dimensions for the carbon beds

(c) pressure drop

(d) Draw a graph representing elution of a fixed bed. [2+6+5+3]

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